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Page : 2

REMARKS

Claims 2, 4-14 and 16-21 are pending and under consideration in the application.

Prior Art Rejections

Claims 2 and 4-11 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Kaminaga et al. (U.S. Patent No. 6,257,215) in view of Shin et al., (U.S. Patent No. 6,593,404).

The claims are directed to an encapsulated, overmolded and/or underfilled electrical component in which the encapsulant, overmolding and/or underfilling is a polymeric composite including a resin matrix containing 20% or less of an inorganic filler comprising particles having a platelet structure. It has been discovered that the desired match between the coefficient of thermal expansion of the polymeric composite and the electrical components can be achieved using a surprisingly low filler content if the filler particles have a platelet structure.

The Examiner has relied on the Kaminaga et al. patent for disclosing an encapsulated, overmolded and/or underfilled electrical component utilizing an epoxy resin system having a particularly high filler content of 70-90 percent by weight. The Shin et al. patent is relied on for disclosing "a semiconductor device comprising particles having a platelet structure defined by opposite substantially flat and substantially parallel faces . . . the inorganic filler content being 20% or less by weight based on the weight of the polymeric composite. . .." The Shin et al. patent does not actually disclose a semiconductor device or provide any teaching relevant to encapsulating, overmolding, or underfilling electrical components. The Examiner has admitted that the Kaminaga et al. patent fails to disclose either the required platelet structure or the required 20% or less filler content, but has taken the position that it would have been obvious to one having ordinary skill in the art at the time the invention was made "to substitute the particles of Kaminaga et al. by having inorganic fillers such as montmorillanite, as taught by Shin et al., in order to provide excellent stress cracking resistance and improve heat resistance (column 2, lines 54-56) and improve adhesion for the semiconductor package."

The Kaminaga et al. patent discloses a resin-sealed electronic apparatus in which an electrical component is encapsulated, overmolded and/or underfilled with a polymeric composite. However, as stated by the Examiner, the Kaminaga et al. patent "fail[s] to disclose the particles having a platelet structure and the inorganic filler content being 20% or less by weight based on the weight of the polymer composite." To the contrary, Kaminaga et al. patent discloses an encapsulated, overmolded and/or underfilled semiconductor device in which the encapsulant, overmolding and/or underfilling is a composite comprising an epoxy resin matrix containing 70 to 90 weight percent of an inorganic filler (see the abstract; column 2, lines 61-63; column 3, lines 1-5; column 6, lines 3-9; claim 1; and claim 5). The Kaminaga et al. patent discloses (column 6, lines 13-21 and column 6, lines 51-61) that the high filler loading is needed to maintain a coefficient of thermal expansion (CTE) midway between the CTE of silicon and the CTE of the heat sink (e.g., copper), and to suppress deformation of the semiconductor device during thermal cycling. Further, the Kaminaga et al. patent teaches (column 6, lines 10-13) that the filler should be a "rounded filler . . . in order to reduce or minimize risks of damage at the semiconductor device . . . ."

Thus, it is undeniable that the Kaminaga et al. patent teaches the following:

1. a very high filler loading of 70-90 weight percent is needed to achieve the desired coefficient of thermal expansion; and
2. a rounded filler is needed to reduce or minimize risks of damage at semiconductor components.

These teachings are strikingly different from the claimed invention which requires a filler content of "20 percent or less by weight based on the weight of the polymer composite," and "particles having a platelet structure defined by opposite substantially flat and substantially parallel faces."

The Shin et al. patent does not provide any teaching specifically addressing encapsulation, overmolding or underfilling of an electrical component. Instead, the Shin et al. patent discloses a flame retardant polycarbonate resin composition that overcomes prior art problems of polycarbonate resins employing conventional phosphate ester-based flame retardants, which "cause deterioration of heat resistance, occurring of stress cracking by volatilization of a flame retardant, and juicing during a molding process." These problems are

overcome by combining a blend of polycarbonate, styrene-containing graft copolymer, a rubber, an alkyl substituted monophosphate ester, and a fluorinated polyolefin. Conventional additives (including fillers, thermal stabilizers, antioxidants, light stabilizers, plasticizers, pigments, dyes, and mold releasing agents) may optionally be employed in an amount up to about 50 parts by weight per 100 parts by weight of resin. Disclosed fillers include mica, talc, zeolite and montmorillanite. There is not any specific disclosure of how the resin compositions of the Shin et al. patent are used. There is only the vague suggestion that such compositions have been "used for parts of electrical products and automotive components because they have a good combination of transparency, high impact strength, and heat resistance," and that polycarbonate molding compositions have been "used for parts of home and office appliances." This does not suggest that the polycarbonate compositions of the Shin et al. patent are useful for underfilling, overmolding or encapsulating an electrical component. Nor is there any suggestion that the Shin et al. compositions have appropriate attributes and characteristics that would be useful for underfilling, overmolding, or encapsulating an electrical component.

The Kaminaga et al. patent discloses that the desired attributes of a polymer composition used for overmolding, underfilling and/or encapsulating an electrical component relate primarily to the coefficient of thermal expansion, and transfer moldability (e.g., column 6, lines 7-9 and column 7, lines 1-5). The Kaminaga et al. patent also discloses that the encapsulation/overmolding and/or underfilling compositions provide rigidity to secure the electronic components together (e.g., column 6, lines 57-61) and that the cured composition is harder than traditional epoxy compositions used in similar applications (e.g., column 3, lines 26-31).

Thus, the important attributes and/or characteristics of an overmolding, underfilling and/or encapsulating polymeric composition disclosed in the Kaminaga et al. patent include coefficient of thermal expansion, resin transfer moldability, rigidity and hardness. The important attributes and/or characteristics of the polycarbonate resin described in the Shin et al. patent include flame-retardancy, resistance to stress cracking, transparency, high impact strength and heat resistance. Thus, there is not any correspondence between the requirements for an overmolding, underfilling and/or encapsulating polymeric composition for electronic components, and the characteristics or attributes of a flame-retardant polycarbonate resin.

Therefore, one having ordinary skill in the art would not be motivated to use the materials of the Shin et al. patent in place of the epoxy resin overmolding, underfilling and/or encapsulating resins disclosed by Kaminaga et al. To the contrary, those having ordinary skill in the art would expect the flame retardant polycarbonate resin compositions of the Shin et al. patent to be particularly unsuitable for overmolding, underfilling and/or encapsulating electronic components, since they would not be expected to have the required coefficient of thermal expansion, resin transfer moldability, rigidity or hardness. Instead, the person of ordinary skill in the art would expect, based on the low filler content, that the materials of the Shin et al. patent would not have a suitable coefficient of thermal expansion. Further, those having ordinary skill in the art would expect a flame-retardant polycarbonate resin composition containing a filler having a platelet structure to be particularly unsuitable in view of the fact that the Kaminaga et al. patent discloses the use of rounded fillers to avoid or reduce a risk of damage to the electronic components during overmolding, underfilling and/or encapsulating.

Thus, the Kaminaga et al. patent teaches against the claimed invention, and the Shin et al. patent does not provide any teaching, suggestion or motivation for using the disclosed flame-retardant polycarbonate resin compositions for underfilling, overmolding and/or encapsulating an electronic component.

Upon considering the requirements described by the Kaminaga et al. patent for an overmolding, underfilling and/or encapsulating resin composition, and comparing them with the features and attributes of the flame-retardant polycarbonate resin compositions of the Shin et al patent, it will be apparent that there is not any teaching, suggestion or motivation for using the thermoplastic resin compositions of the Shin et al. patent in place of the epoxy resin systems of Kaminaga et al., since those of ordinary skill in the art would not expect an acceptable result. Accordingly, withdrawal of the rejection is requested.

Claim 12 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Kaminaga et al. (U.S. Patent No. 6,257,215) in view of Shin et al. (U.S. Patent No. 6,593,404) and further in view of Capote et al. (U.S. Patent No. 6,335,571).

Dependent claim 12 further limits claim 4 by requiring a CTE of 5 to 20 ppm/°C for the composite.

The Examiner has relied upon the Kaminaga et al. patent and the Shin et al. patent for the reasons stated above with respect to the rejection of claims 2 and 4-11. The Capote et al. patent is relied on to show a semiconductor device comprising a composite having a coefficient of thermal expansion from about 5 to about 20 ppm/°C. The Examiner has taken the position that it would have been obvious to one having ordinary skill in the art at the time the invention was made to somehow "modify the device of the above combination [Kaminaga et al. in view of Shin et al.] to minimize the stress on the soldered joint for the composite, as shown by Capote et al. (column 8, line 17-19)."

Dependent claim 12 is allowable for the reasons set forth above. Specifically, because the Kaminaga et al. patent expressly teaches that it is necessary to utilizing a high filler loading of 70-90% by weight, not the required 20% or less, and not the 0-50% amount specified in the Shin et al. patent, and that rounded filler particles are needed, rather than the required particles having a platelet structure, there is not any suggestion or motivation for using the Shin et al. flame-retardant polycarbonate compositions for overmolding, underfilling and/or encapsulating electronic components.

Furthermore, one having ordinary skill in the art would not be motivated to modify the polycarbonate resins of the Shin et al. patent based on the teachings of the Capote et al. patent, since the Capote et al. patent discloses conventional epoxy resin systems employing conventional amounts of conventional round fillers, such as silica powder and glass bubbles. Example 1 discloses an epoxy resin portional encapsulant having a coefficient of thermal expansion of about 180 ppm/°C. Example 2 describes an epoxy resin underfill encapsulant containing 40% glass spheres. Example 3 discloses an epoxy resin encapsulant containing 64% filler. Thus, rather than teaching or suggesting the claimed invention, the Capote et al. patent leads those having ordinary skill in the art toward conventional fillers employed at conventional loading levels, and away from the claimed invention.

Claims 13, 14 and 16-20 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Kaminaga et al. in view of Shin et al.

These claims are directed to an electrical component that is encapsulated, overmolded and/or underfilled with a polymeric composite including a thermoplastic resin matrix and an inorganic particulate filler. The prior art does not teach or suggest a thermoplastic resin in a polymer composite used for overmolding, underfilling and/or encapsulating an electrical component.

The Examiner has relied on Kaminaga et al. for disclosing an encapsulated, overmolded, and/or underfilled electrical component in which the overmolding, underfilling and/or encapsulant is an epoxy resin package containing an inorganic particulate filler. The Examiner has relied on Shin et al. for disclosing a "semiconductor device comprising a thermoplastic resin composition including an inorganic particulate filler (abstract)." The Examiner's reliance on Shin et al. is inappropriate. The Shin et al. patent does not disclose any semiconductor devices. Instead, the Shin et al. patent discloses flame-retardant polycarbonate resins that are apparently useful for making parts of electrical products, automotive components, parts of home appliances, and parts of office appliances. The disclosure is not specific as to what types of parts are contemplated. Regardless, the use of a flame-retardant polycarbonate resin composition for making automotive parts, electrical products parts, and/or appliance parts, does not suggest that such compositions would be useful for overmolding, underfilling and/or encapsulating electronic components. The Kaminaga et al. patent teaches against using thermoplastic compositions for underfilling, overmolding or encapsulating electrical components, but instead teaches that epoxy resin systems containing a very high filler content (e.g., 70-90%) are needed. The Shin et al. patent is also relied on by the Examiner for disclosing a flame-retardant polycarbonate resin composition that may optionally contain inorganic filler in an amount of 0-50 parts by weight based on 100 parts by weight of the resin components, for disclosing montmorillanite filler, and for disclosing polycarbonate resin compositions.

The Examiner has taken the position that it would have been obvious to one having ordinary skill in the art at the time the invention was made to select the thermoplastic resin composition of Shin et al. for use as an overmolding, underfilling and/or encapsulating composition rather than the epoxy resin compositions having a high content of rounded filler particles that are require by the Kaminaga et al. patent.

For the reasons generally set forth above with respect to claims 2 and 4-11, those having ordinary skill in the art would not be motivated to utilize the Shin et al. flame-retardant polycarbonate resin compositions for underfilling, overmolding and/or encapsulating electronic components in place of the high filler loading epoxy resin compositions disclosed by Kaminaga et al. Those having ordinary skill in the art would not expect the low filler loadings of Shin et al. to be suitable for achieving the required coefficient of thermal expansion based on the teachings in the Kaminaga et al. patent that a filler loading of 70-90% is needed, and those having ordinary skill in the art would not expect montmorillanite filled composites to be suitable for overmolding, underfilling and/or encapsulating electronic components, since montmorillanite has a platelet structure, rather than the rounded structure which, according to Kaminaga et al., is needed for preventing and/or reducing damage to the electronic components during overmolding, underfilling and/or encapsulation.

The Examiner has suggested that the rejection is appropriate because the selection of a known material based on its suitability for its intended use supports a *prima facie* obviousness determination. However, the Shin et al. patent does not teach or suggest that the flame-retardant polycarbonate resin compositions are suitable, or are intended to be used, for overmolding, underfilling and/or encapsulating electronic components. Moreover, those having ordinary skill in the art would expect from the Kaminaga et al. patent that the materials of Shin et al. are unsuitable because they do not employ a sufficient amount of filler to achieve the desired coefficient of thermal expansion, and do not contain a rounded particulate filler which is needed to prevent and/or reduce damage to the electrical components during overmolding, underfilling and/or encapsulation. For these reasons, motivation for employing the compositions of the Shin et al. patent for overmolding, underfilling and/or encapsulating electronic components is lacking.

Claims 21 and 22 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Kaminaga et al. in view of Shin and further in view of Yu et al. (U.S. Patent No. 5,153,657).

Claims 21 and 22 are directed to electrical components overmolded, underfilled or encapsulated with a composite comprising a thermoplastic resin filled with glass spheres.

The Examiner has relied on Kaminaga et al. and Shin et al. for substantially the same reasons as set forth above with respect to the previous rejections. The Yu et al. patent is relied

on for teaching the use of inorganic glass spheres as a filler. The Examiner has taken the position that it would have been obvious to one having ordinary skill in the art to use glass spheres in "the device structure of the above combination [Kaminaga et al. in view of Shin et al.] for forming the inorganic fillers as claimed since the glass spheres would maintain good conformance in the lateral direction (column 12, lines 31-32)."

None of the prior art references, either alone or in combination, teach or suggest the use of a thermoplastic resin for underfilling, overmolding and/or encapsulating electronic components. To the contrary, the prior art only discloses the use of thermosetting resins, most typically epoxy resin systems, for underfilling, overmolding and/or encapsulating electronic components. As stated before, the Kaminaga et al. patent only discloses the use of thermosetable epoxy resins containing a very high filler content of 70-90% by weight, wherein the fillers are comprised of rounded particles that reduce and/or prevent damage to the electronic components during overmolding, underfilling and/or encapsulating. The Shin et al. patent discloses flame-retardant polycarbonate resin compositions that employ up to 50 parts by weight of a filler per 100 parts by weight of resin, but does not teach or suggest that these compositions would be suitable for overmolding, underfilling and/or encapsulating electronic components. Those having ordinary skill in the art relying on the teachings of the Kaminaga et al. patent would not expect such compositions to be suitable as encapsulants, overmoldings and/or underfillings for electrical components, since they are thermoplastic, rather than thermosetting materials, and because they contain insufficient quantities of filler, not the 70-90% filler content required by the Kaminaga et al. patent. The teachings of the Yu et al. patent are completely unrelated to both the teachings of the Kaminaga et al. patent and the Shin et al. patent. The Yu et al. patent discloses the use of glass spheres in a thermoset elastomeric matrix formed into the shape of a cleaning blade. This does not suggest the use of glass spheres in a hard, rigid matrix of the type disclosed in the Kaminaga et al. patent. Nor does it teach or suggest the use of glass spheres in a thermoplastic resin. The fact that the Yu et al. patent discloses the use of glass sphere reinforcing filler in an elastomeric thermoset material to "improve the blade's wear resistance and tear toughness, as well as reducing its contact friction against a charge retentive surface of an electrophotographic imaging member while maintaining good conformance in the lateral direction" is irrelevant to the teachings of

Kaminaga et al. and Shin et al., and does not have a bearing on the types of materials and/or composites that would be useful for overmolding, underfilling and/or encapsulating electronic components. Accordingly, a withdrawal of the rejection is appropriate.

CONCLUSION

In view of the above amendments and remarks, it is respectfully submitted that the application is in condition for allowance and notice of the same is earnestly solicited.

Respectfully submitted,

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